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Recent Studies of Rainfall in Germany

(1) *Regenbeobachtungen, Wasserstands und Wassermengenmessungen* By F. Reinhold, Städtereinigung, Berlin, 27, 1935, pp. 666–9.

(2) *Grenzwerte starker Regenfälle.* By F. Reinhold, Gesundheitsing, Berlin, 58, 1935, pp. 369–70.

(3) *Einige Sonderfragen zur Durchführung und Auswertung von Regenbeobachtungen.* By F. Reinhold, Gesundheitsing, Berlin, 58, 1935, pp. 612–8 and pp. 626–30.

(4) *Die einheitliche Durchführung von Niederschlagsmessungen.* By F. Reinhold, Gesundheitsing, Berlin, 58, 1935, pp. 692–700.

These four papers by Dr. Reinhold of Dresden, published in periodicals circulating among municipal engineers and sanitary authorities, contain much matter of interest to students of rainfall. In this brief note I propose to refer in particular to papers (2) and (3) because they contain data relating to a subject which has recently received much attention in this country, namely the duration and intensity of heavy falls. An analysis of results obtained in the British Isles has recently been published* and it is proposed to publish in *British Rainfall*, 1935, a further paper on the classification of heavy falls in short periods, based on the same data. Dr. Reinhold's papers afford a welcome opportunity of comparing ideas in regard to this very important branch of rainfall study.

* The incidence of intense rainfall as shown by autographic records—*London, Water and Water Engineering*, 37, 1935, pp. 622–6.

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

In paper (2) Dr. Reinhold uses data from Dresden to determine the form of the relation between i the average intensity in millimetres per minute and T the duration in minutes, for various classes of intense rainfall. He distinguishes three classes, "Starkregen," "Platzregen" and "Wolkenbruch," which may be roughly rendered into English as "intense rain," "violent rain" and "torrential rain," and he reaches the conclusion that the lower limits of intensity for the three classes may be represented by curves of the form $i = C/(T + b)^a$; for all three classes the values of the constants b and a are 18 and 0·765 respectively; the constant C has the value 9·0 for "Starkregen," 13·5 for "Platzregen," and 18·0 for "Wolkenbruch." By multiplying the intensity by the time in minutes we obtain values of the total fall in time T which we can compare directly with the lower limits adopted in *British Rainfall* for the classification of heavy falls in short periods. The results of such a comparison are given in Table I. It will be seen that a Dresden

TABLE I.—Lower limits of intense rainfalls (millimetres)

Time in minutes.	5	10	20	30	60	90	120
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
	Dresden (F. Reinhold)						
Starkregen	4·1	7·0	11·1	13·9	19·2	22·7	24·8
Platzregen	6·1	10·5	16·7	20·9	28·8	34·1	37·2
Wolkenbruch	8·2	14·0	22·1	27·8	38·4	45·4	49·6
	British Rainfall (H. R. Mill, introduced in 1908)						
Noteworthy	4·1	7·6	13·5	17·8	25·4	29·2	31·3
Remarkable	9·4	16·5	26·9	34·3	44·5	48·0	49·3
Very Rare	14·7	25·4	40·1	50·8	57·4	66·0	67·3
	British Rainfall (from January 1st, 1936)						
Noteworthy	10·9	13·8	17·3	19·7	24·5	27·8	30·4
Remarkable	17·3	21·6	26·8	30·3	37·6	42·4	46·2
Very Rare	26·8	33·2	40·9	46·2	56·8	64·0	69·4

"Starkregen" lasting 5 minutes just reaches the old *British Rainfall* "noteworthy" limit but no "Starkregen" would now qualify for that classification. A "Platzregen" lasting more than about 25 minutes would qualify as "noteworthy"; a "Wolkenbruch" lasting 10 minutes would qualify as "noteworthy" and one lasting 60 minutes would qualify as "remarkable."

The new limits in the *British Rainfall* classification, introduced January 1st, 1936, are computed to give a uniform frequency of incidence; thus, taking the "noteworthy" limits, a fall of 10·9 mm. in 5 minutes or less may be expected to occur neither more nor less

often than a fall of 19·7 mm. in 30 minutes or less, or 27·8 mm. in 90 minutes or less. In other words, the limiting curves are "constant-frequency" graphs. We therefore turn with interest to a table in paper (3) which gives frequency data for various types of intense rain at Dresden. The table gives the mean intensity of rains lasting from 5 to 200 minutes which occur at Dresden on the average n times per year, data being given for $n = 0\cdot2, 0\cdot5, 1\cdot0, 2\cdot0$ and $3\cdot0$. The intensities are stated in terms of a rather peculiar unit, namely, litres per second per hectare. Since 1 mm. of rain is equivalent to 10,000 litres per hectare we can compute the corresponding total amounts of rain in millimetres and compare these with corresponding British data. Table II shows the results for times 5 to 100 minutes

TABLE II.—COMPUTED AMOUNTS OF RAIN FALLING IN STATED TIMES WITH A FREQUENCY OF (*a*) ONCE IN 5 YEARS, (*b*) ONCE A YEAR

Time	Once in 5 years.		Once a year.	
	Dresden.	England and Wales.*	Dresden.	England and Wales.*
	mm.	mm.	mm.	mm.
5 min. or less ...	7·7	8·4	4·3	4·6
10 „ „ ...	12·7	10·9	7·2	5·8
20 „ „ ...	18·7	14·0	10·7	7·9
30 „ „ ...	22·0	15·7	12·4	9·1
40 „ „ ...	23·5	17·5	13·7	10·2
60 „ „ ...	26·3	19·8	15·5	11·7
100 „ „ ...	28·2	23·1	17·4	14·0

* Average of 12 stations 1925–34.

corresponding to frequencies $n = 0\cdot2$ (once in 5 years) and $n = 1$ (once a year). The British data given in this table are computed from 10 years' observations at 12 stations in England and Wales. It will be noticed that the amounts of rain falling in stated times are substantially greater at Dresden than in England and Wales, except for a time of 5 minutes or less. It appears, therefore, that Dresden is more liable than most parts of England to heavy rains of moderate duration.

E. G. BILHAM.

Thunderstorms in the Tasman Sea and Coral Sea, March, 1934

BY H. C. WEBSTER, PH.D., F.INST.P., G. H. MUNRO, M.SC., A.M.I.E.E., AND A. J. HIGGS, B.SC.

Owing to the absence of fixed observing stations, relatively little is known concerning sea thunderstorms. The wireless direction-finders for atmospherics, developed by the British Radio Research

Board, have been used in Australia to locate sea thunderstorms (strictly groups of thunderstorms, which have been termed "sources"). Observations from Toowoomba and Canberra D.F. stations during March, 1934, gave reasonably accurately the locations of most, if not all, the active sources occurring in the Tasman Sea and Coral Sea. Frontal weather analysis of this region was carried out by the New Zealand Meteorological Office during this period and through the kindness of Dr. W. A. Macky of that office we have been able to compare the positions of the sources with the fronts.

We have classified the sources as "frontal" or "non-frontal", defining as frontal all sources which are near fronts or occlusions—allowing a generous margin of proximity on account of (*a*) inaccuracies in the location of the sources, (*b*) inaccuracies in the placing of the fronts and (*c*) movements of the fronts. In Fig. 1 the frontal sources are indicated by crosses and non-frontal sources by dots. It will be noted that in the lower latitudes non-frontal sources are in the majority. Table I makes this clear.

TABLE 1.—NUMBERS OF SOURCES LOCATED WITHIN EACH 5° INTERVAL OF LATITUDE

Latitudes. S.	Frontal sources.	Non-frontal sources.	Percentages of frontal sources.
10°–15° ...	1	6	12
15°–20° ...	9	15½*	37
20°–25° ...	14½	17½	45
25°–30° ...	11½	19	38
30°–35° ...	4½	2½	64
35°–45° ...	6½	1½	81

For thunderstorms over land it is permissible to assume that the majority of non-frontal sources would consist of thunderstorms of the "heat" type. In the case of sea sources, however, this appears improbable, since it is difficult to picture the normal mechanism of heat thunderstorms taking place at sea. The upper air instability, which supplies the bulk of the energy for the thunderstorm is of course not affected by the nature of the surface, but the necessary trigger action is ordinarily supplied by the convectional instability in the lower levels due to excessive surface heating. It is probable that additional secondary fronts, not shown in the New Zealand analysis, were present. Meteorological data for the area are too sparse to allow the detection of secondary fronts. Many of the sources were situated in low pressure areas which may have contained secondary fronts. Some of the thunderstorms, particularly for latitudes north of 25° were possibly heat thunderstorms over islets and reefs.

It has been suggested that the minor temperature discontinuities

* A source located on a boundary line is counted as half a source in each of the relevant squares.

where two ocean currents meet could possibly give the necessary trigger action. The chief ocean currents are indicated in the diagram.

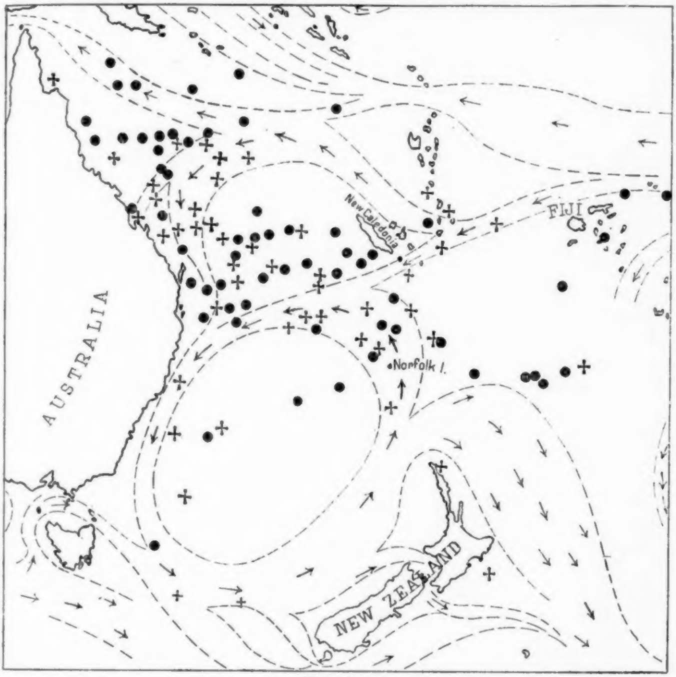

FIG. 1.

It will be seen that many, but not all, the non-frontal sources were situated in the region where the north-moving current from the west coast of New Zealand joins the south-west moving current from the Fiji Islands. Another group of heat sources occurs where a branch from the New Zealand current meets another branch of the Fiji current. The evidence as a whole is, however, inconclusive.

Particular interest attaches to a source which appeared to continue for four days having the following approximate locations at the times stated :—

2300 on 20th	22°	164°
1200 on 21st	22°	160°
1200 on 22nd	23°	158°
1200 on 23rd	21°	158°

and lasting until 0600 on the 24th.

No fronts were recorded in the vicinity during this period. The

mechanism of production of these long-lived sources is still obscure. These results suggest that they are not due to slow-moving fronts.

Mediæval Weather Lore *

"Autres temps, autres moeurs"—in other words, it is hard to get inside the minds of our forefathers. The curious fact that in matters of astrology some of our forefathers are still alive does not make it any easier for the modern meteorologist to understand the peculiar weather "science" of the middle ages. Dr. Thorndike, in his notable compilation on the history of magic, quotes numerous references to the power of magic or astrology in making or foretelling the weather, which was an article of common faith even among the learned. Thus in 1326 the Pope, who was presumably a reasonably intelligent man, commissioned a Cardinal to judge the case of a Canon at Agen accused of invoking evil spirits to produce hail and thunderstorms and to kill men. In a book by Mark Twain the witch made a storm by taking off her stockings; we are not told how the Canon did it.

The methods of weather prediction described by Thorndike fall into two classes—astrological and homely. One thinks of the "Science" of the Middle Ages as largely based on classical and Arabian sources, but it appears that in the first half of the fourteenth century there was a great deal of original writing on the subject, much of it by English authors, and Thorndike adds something to the well-known chapters by Hellmann on Mediæval meteorology.† The most noteworthy author is Robert of York ("Perscrutator", c. 1340), whose argument is briefly as follows:—

Because the world needs rain and evaporation for the generation and growth of vegetation and support of animal life, there are certain parts of the Zodiac in which the sun elevates waters, "now strongly, now more strongly, now most strongly", and others in which the sun causes no evaporation or scarcely any or but weakly. These six varieties of places are designated by the names of as many colours . . . white, yellow, red, black, green and jacinth, the lighter colours indicating the sun's power of evaporation, and the darker ones its absence. There are also dry, wet and neutral degrees among the signs . . . The exaltations of the planets in the signs are also taken into account. Thus about 1255 the influence of Saturn caused cold weather for five years running.

Thorndike gives a good deal more to the same effect, but repetition would be wearisome. To us it all sounds pretty much alike, but

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* THORNDIKE, L.—A history of magic and experimental science. Vol. III and IV. Fourteenth and Fifteenth centuries. (History of Science Society Publications, New Series, 4). Columbia (Univ. Press), 1934.

† HELLMANN, G.—Beiträge zur Geschichte der Meteorologie, II. Berlin, 1917, pp. 167–229.

there were weighty and dignified arguments, carried on in Latin treatises with sonorous and learned titles. " De iudiciis universalibus mutationum aeris per coniunctiones et oppositiones luminarium " somehow sounds much more compelling than " The influence of the sun and moon on the weather ", but the contents of such a work are about as intelligible to the modern meteorologist as a work on frontogenesis would have been to the ancients. The arguments are specious, based on false analogy and misunderstood premises, but the writers presumably believed in themselves, and the appearance of learning goes a very long way. So they had their patrons, who no doubt loudly applauded their successes and loyally forgot their failures. Even before the end of the fifteenth century, however, there are signs that the natural intelligence of the race was beginning to assert itself. The Rev. William Merle (Thorndike uses the alternative spelling Merlee), who was the first known person to keep a systematic record of the weather over several years, also wrote a work on weather forecasting, but although one copy is entitled " A Physical Treatise concerning favouring Stars ", Merle puts little faith in astrological methods, as against more homely weather lore—the biting of flies, audibility of bells, etc. Merle had a truly scientific mind, and it is not without interest that in one chapter he discusses the mental qualifications and experience required to make a successful weather forecaster. Later writers were more outspoken in their criticisms of astrological methods, and failures received unkind publicity. Thus it was remarked that although a very cold winter was predicted for 1373, the actual weather was very warm, while astrologers failed to predict great inundations throughout France and Germany in January, 1373. Astrological methods continued to be advocated for some centuries however, and the invention of printing gave them a new lease of life. Even today they are barely extinct, for a pamphlet " The weather forces of the planetary atmospheres " appeared in 1905, and still more recent examples could be quoted.

Turning now to the homely weather signs, we find a good deal of keen observation mixed with some utter nonsense. Thus, Nicholas of Cusa, about 1439, devised a method of weather prediction by weighing wool exposed to the air to determine the humidity. But even sound ideas can be pushed to fantastic extremes, and we read elsewhere : " To predict the weather for the ensuing year, before going to midnight mass one put salt in twelve split onions representing the months of the year and on returning estimated the humidity of each month by the state of the salt in each onion ". Perhaps even more extraordinary is the prognostic from Munich (1487), " If in autumn the cows lie on their right sides, the winter will be severe, but if they recline on their left sides, it will be mild ".

Enough has been said to show that these two volumes make an important contribution to the early history of meteorology, but

mention must also be made of a note to the important chapter (Vol. III, Ch. IV) on " Weather records : William Merlee and Evno of Würzburg ". The passage runs : " Mr. Robert Steele calls my attention to notes recording the weather in the margin of planetary tables for the year ending 28 February, 1269–1270, in the left-hand margins of BM Royal 7 F VIII, fols. 176V–179V. This earlier record was for seven months, beginning in August with two brief jottings and becoming quite full for the last three months of December, January and February ". This record antedates Merle's by nearly seventy years, and is the earliest known in this country. Though not systematic, it is of great historical interest, and Mr. C. E. Britton, acting on a reference contained in a review in *Nature* (137, 1936, pp. 340–1), has obtained a photostat copy from the British Museum, which he has kindly presented to the Meteorological Office Library.

C. E. P. Brooks.

OFFICIAL PUBLICATION

The Weather Map. An introduction to modern meteorology. 2nd edition. (M.O. 225i).

The Weather Map first appeared in 1915 and met with such a ready sale that five reprints were needed within ten years. In 1930 a new edition was prepared covering the latest developments in forecasting from daily weather maps and the demand for this second edition has been such that a third reprint has just appeared. This reprint differs from the previous issue only in the definitions of cloud forms which have been brought into conformity with the new International Cloud Atlas issued by the International Meteorological Committee in 1932. The Weather Map which is published by H.M. Stationery Office at 3*s*., describes the preparation of the weather maps which are now studied by an increasing number of people and gives its readers an understanding of the methods adopted by the Meteorological Office in the preparation of weather forecasts. It is widely used in schools.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday evening, March 18th in the Society's rooms at 49, Cromwell Road ; Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair. As is customary in March the meeting took the form of a lecture, the Symons Memorial Lecture, which was delivered on this occasion by Dr. F. Loewe of the Scott Polar Research Institute, Cambridge, his subject being :—

The Greenland ice-cap as seen by a meteorologist.

The Greenland ice-cap covers a surface seven times as big as Great Britain ; it extends from the latitude of the Shetlands to near the northernmost land on earth. The continuous ice sheet forms special climatic conditions unique on the northern hemisphere. The main region for the formation and regeneration of cyclonic

depressions south of Iceland is not very far from Greenland. As these depressions have a great influence on the weather of western Europe it is a question of scientific as well as practical importance to know whether it is the interaction of cold air from the ice-cap and warm maritime air which forms these depressions. The practical value of the meteorology of the ice-cap is strengthened by the fact that the shortest way from Europe to the interior of North America leads over Greenland.

Before 1930 the ice-cap was known from sledge journeys during the summer only. In 1930–1 the British Arctic Air Route Expedition, led by H. G. Watkins and the German Greenland Expedition, led by Alfred Wegener, wintered on the ice-cap. The lecturer stayed at one of the German stations, Mid-Ice, which with an annual mean temperature of — 22° F. and a minimum of — 85° F. proved to be the coldest place on earth where continuous observations have been taken. Based on his experiences at this station and during sledge journeys, the lecturer gave a description of the typical weather conditions in different seasons, and of their influence upon the surface of the ice-cap and the conditions of travelling. The most important climatic feature is a relatively shallow layer of cold air covering almost continually the surface of the ice-cap and flowing down the slopes under the influence of gravity. Whether the energy of this "skin" of cold air is sufficient to give birth to high-reaching and powerful depressions cannot yet be said; regarding the vastness of the region and the scientific problems involved, the results of the last expedition, useful as they are, must be regarded only as pioneer work for further research.

Correspondence

To the Editor, *Meteorological Magazine*

Peculiar phenomenon of March 15th, 1936

This morning the weather was overcast in a normal way and continued so till I went to a concert at about 14h. 45m. On leaving the hall at about 16h. 30m. I found everything like a London fog, the sky covered with low dark clouds, lights in vehicles and in houses, the landscape bathed in a weird, unwholesome, yellowish-grey light. The sea was very smooth and glassy, visibility was I think about 4 to 5. There was a slight drizzle, enough to mark the pavements. The clouds were not continuous and were moving from a westerly direction. I am told the darkness set in rather suddenly about 15h. 15m. About 17h. 10m. it began to lighten and in a few minutes it was possible to dispense with artificial lights. Now (17h. 40m.) pale misty blue sky is visible and the wind has freshened somewhat (NE.). The occurrence reminds me somewhat of the "black-out" described on p. 66 of the 1935 volume of the *Meteorological Magazine*.

CICELY M. BOTLEY.

17, *Holmesdale Gardens, Hastings, March* 15*th*, 1936.

Squall Cloud, Tananarive

Having recently read the November, 1934 issue of the *Meteorological Magazine*, my attention was called by the picture of a cloud drawn by Mr. Donald L. Champion (p. 238). The cloud he had observed is nearly like a type of cloud I have seen along the coasts of Madagascar and I am calling "Stratocumulus bourgeonnant" (budding stratocumulus). On the west coast that cloud gives birth very often to some showers but rarely to true squalls ; on the contrary on the east coast, for example in the part of that coast near Tamatave, it can be thought of as a squall cloud but without any violence.

Precise considerations about this cloud would be too long to be written in this short note ; but I am sending you, to explain it, the enclosed photograph taken on the west coast at Majunga on the eleventh of January, 1934, at 10h. 10m. in direction of the centre of Bombetoka Bay, direction, south-south-west (*see* opposite page).

J. Mondain.

Service Météorologique, Tananarive, Madagascar, November 10*th*, 1935.

Effect of wind on Macrocarpa tree

I am forwarding a photograph (*see* opposite page) taken by myself at Waipapapa Point, on the south coast of the South Island, 23 miles east of Bluff and at the eastern entrance to Foveaux Strait, New Zealand. The photograph shows in a striking manner the effect of the strong prevailing winds between NW. and SW. on a macrocarpa tree. Foveaux Strait separates the South and Stewart Islands, averages about twenty miles in width and runs in a general easterly and westerly direction between latitudes 46° and 47° S.

The tree, if upright, would be about 30 feet high, its present height being 10 feet, and is one of a number, all similarly shaped, planted some years ago as shelter for the gardens of the lighthouse keepers at Waipapapa Point. The surrounding country is low lying and level for several miles and the principal vegetation is grass with areas of short scrub.

R. G. Simmers.

Meteorological Office, Wellington, New Zealand, February 12*th*, 1936.

Tracking Thunder

The Thunderstorm Survey was this year extended to the winter months and will be continued throughout the coming summer. Some of your readers have very kindly given most valuable assistance in the observational work in the past, and I venture to hope that many may be good enough to join in the census during the coming season.

A note of the place, date and time of the occurrence of thunder, lightning or hail, with the direction in which the lightning was seen,

[facing p. 66

(reproduced by the courtesy of Mr. Mondain)

STRATOCUMULUS BOURGEONNANT AT TANANARIVE.

(reproduced by the courtesy of Mr. Simmers)

MACROCARPA TREE SHOWING EFFECT OF PREVAILING WINDS.

especially at night, will be extremely useful. Additional information of the following character will be valuable :—

1. Time of first observation of thunder or lightning, with direction and estimated distance.
2. Time of commencement of very heavy rain or hail, or approximate time of nearest approach of storm, with direction and estimated distance.
3. Approximate time of final observation of thunder or lightning, with direction.
4. Severity of storm ; changes in direction or strength of wind, changes in temperature, etc., during the storm.

The Lightning Damage Survey has now been commenced in some districts, maps have been issued to observers and help in noting the positions of damage and co-operating with the observer in charge of the local map will be very welcome.

Sectional organisations now include the investigation of trees struck by lightning, damage to wireless installations, personal injury, structural damage, etc. Full details of the survey will be sent to intending new observers on application to the undersigned.

More records are particularly required in moorland districts and rural areas generally. Records from high-level stations from which it is possible to ascertain the direction and distance of remote storms are very helpful.

The results for the summer of 1934 indicate that there was more thunder in that season than in the same part of any of the previous three years. Thunder or lightning was recorded on 116 days out of 183, in some part of the British Isles. In the distribution map for the third quarter of 1934, included in the report, the storms again tend to group themselves into bands running roughly north-east and south-west, and the main belt of low frequency appears between Dorset and The Wash. S. Morris Bower.

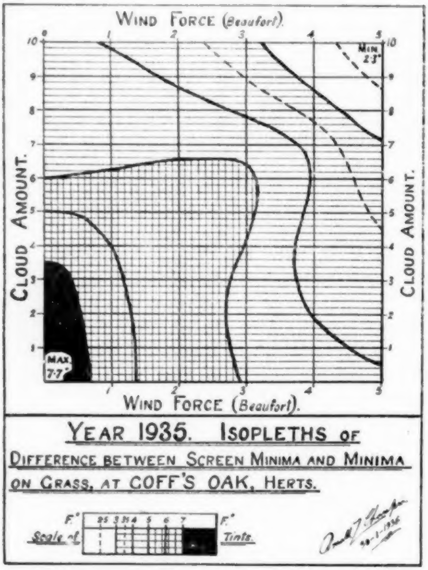
Langley Terrace, Oakes, Huddersfield, March 24th, 1936.

Night Radiation, Wind Force and Amount of Cloud

As a result of a recent request for data relative to ground frosts, some details of the effect of wind and cloud on night radiation during the year 1935 were required, and the data available have renewed the interest in the readings obtained from the grass minimum thermometer. Although only one year's observations were considered, the figures obtained required but little smoothing to produce isopleths showing the depression of the grass minima below screen minima, relative to wind force and amount of cloud.

The resultant isopleth diagram here reproduced, based on observations at Goff's Oak, Herts, is not without interest. The method adopted to obtain these curves was quite a simple matter. Observations of cloud amount and wind force were available for the hours of 7 a.m. and 11 p.m. (clock time) throughout the year,

and the minimum thermometers were set at 11 p.m. and read at 7 a.m. The difference in temperature between the thermometer in the screen and the grass minimum was entered against the observation of cloud and wind at either 11 p.m. on the previous night, or at 7 a.m. on the same morning, whichever value gave the lowest figure for wind force and/or cloud amount. If the cloud amount was the same in each case, but in one case the cloud was of a cirriform character (or of medium height), the temperature difference was allotted to the latter in preference to an observation of low cloud. Owing to few observations of winds above force 5 the data for these winds are grouped together, the readings obtained showing little difference from those with winds of force 5.



YEAR 1935. ISOPLETHS OF DIFFERENCE BETWEEN SCREEN MINIMA AND MINIMA ON GRASS, AT COFF'S OAK, HERTS.

Considering the extremely short period under review, the isopleths are remarkably regular and demonstrate that on the average, the grass minimum will be nearly 8° F. lower than that in the screen when the air is calm and clouds absent; whereas an overcast sky with a wind above force 4 will reduce this difference by over 70 per cent. The resultant effect of wind and cloud in preventing (or reducing the severity of) ground frosts is at once apparent.

If a longer period were considered, the sinuosity of the isopleths of 4° and 5° doubtless would be reduced, but even so, an average difference between the minima of over 4° with 7-tenths cloud and a wind above force 4 seems higher than one would anticipate and in this particular year, may be due to a clearing of the sky during the night which was, however, not apparent at 7 a.m. on the following morning. It is possible that the difference of over 4° with an overcast sky when the air is calm, may be attributed to the occurence of cirriform cloud sheets or thin fogs which are usually treated numerically as low cloud but have much less effect on radiation.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts., January 31st, 1936.

NOTES AND QUERIES

Nocturnal Cooling and the Prediction of night minimum Temperatures

In your issue for April, 1934, R. T. Andrews describes an investigation at Larkhill concerning the prediction of minimum screen temperatures on winter nights. A table is given showing the average fall of temperature during a clear or partly clear night for known values of temperature and humidity at 15h. and for winds of 0–10 m.p.h. and 10–20 m.p.h. A figure is also given showing isopleths of the differences between the 15h. and night minimum temperature.

TABLE I

Mean difference between 16h. temperature and minimum screen temperature on clear or mainly clear nights when wind speed was not greater than 5 m.p.h. at Peshawar, October to March, 1926–35.

Temperature 16h.	45°–54° F.	55°–64° F.	65°–74° F.	75°–84° F.	85°–94° F.	95°–104° F.
Rel. Hum. 16h.		Temperature difference (T–M) °F.				
71–80%	12 (1)	14 (1)	15 (1)	—	—	—
61–70%	14 (3)	17 (9)	18 (1)	20 (1)	—	—
51–60%	16 (4)	19 (21)	21 (3)	22 (1)	—	—
41–50%	19 (4)	20 (32)	23 (33)	25 (9)	26 (3)	26 (1)
31–40%	21 (2)	24 (28)	25 (70)	26 (52)	27 (34)	28 (2)
21–30%	23 (3)	25 (32)	27 (66)	27 (110)	29 (83)	29 (1)
11–20%	25 (1)	27 (29)	28 (34)	29 (43)	30 (26)	31 (2)
0–10%	—	28 (2)	30 (1)	31 (1)	32 (1)	—

Figures in brackets are numbers of observations.

In your issue of May, 1934, Col. E. Gold discusses this investigation and points out that the fall of temperature diminishes in amount as the humidity increases. Col. Gold shows that if the amount of cooling (T — M) is plotted against the difference between the temperature and the dew point (T — D) one obtains a series of parallel

straight lines leading to the formula $T - M = 0{\cdot}4\ (T - D) + 0{\cdot}15T + 5{\cdot}5$.

In your issues for November, 1934, and May, 1935, are recorded the results of similar investigations at Ismailia, Catterick and Abbotsinch. The relation between (T — M) and (T — D) for these stations was found to be very similar to that at Larkhill.

It was decided to carry out the same investigation at Peshawar using the 16h. local time observations. Data were extracted for the period October 1st, 1926 to March 31st, 1935. Peshawar is situated on a gently-sloping horse-shoe shaped plain with mountains all round except for a gap to the east-south-east, the foothills to the west being within 10 miles of the meteorological station. Only nights when the sky was continuously clear, or almost so, were selected. The average wind force was calculated from the difference between the cup anemometer readings at 16h. (local time) and 8h. (local time), the times of routine evening* and morning observations respectively.

Table I gives the mean difference between the 16h. temperature and the minimum screen temperature, during the months October to March, for various values of relative humidity at 16h. when the average wind force was 0–5 m.p.h. Insufficient data were available for preparing a table for nights when the average wind force was greater than 5 m.p.h. In Fig. 1 are drawn the isopleths of these differences. In Fig. 2 the values of (T — M) are plotted against the appropriate values of (T — D). The figures against the curved lines represent the temperature T at 16h. It will be seen that a series of parallel curves are obtained and not straight lines. Evidently the large values of (T — D) obtainable at Peshawar have brought out the true shape of the curve. According to Ångstrom† the net cooling of a horizontal body due to radiation alone involves an exponential factor in terms of e, the vapour pressure. Hence non-linear relationship is to be expected between (T — M) and (T — D).

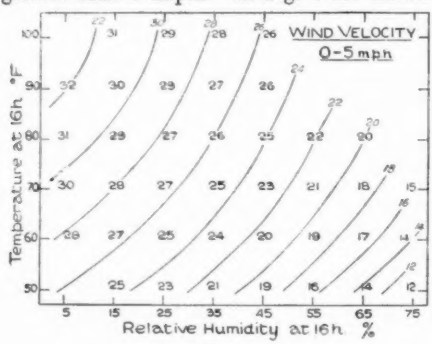


Fig. 1.

The processes taking place in the neighbourhood of the ground

* Since January 1st, 1931, the routine evening observations have been made at 17h. Indian standard time, i.e. 16h. 17m. local time.

† *Washington D.C., Smiths. Inst. Misc. Coll.*, 65, 1915, No. 3.

on radiation nights are undoubtedly complicated by a number of factors. For example, it has been noted that the fall in temperature at Peshawar on clear nights may be considerably less than the mean when there is much dust-haze. Dr. Ramdas of the India Meteoro-

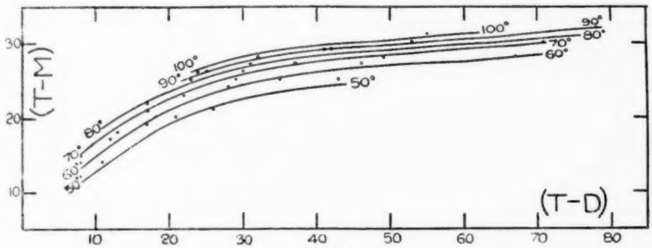


FIG. 2.

logical Department, who is carrying out an intensive study of radiative cooling at night, has observed* that on calm clear nights in winter the lowest temperature is observed to occur not in immediate contact with the ground, but at a distance of half to one foot above the ground. Dr. Ramdas and Dr. Ramanathan have shown† that, besides the cooling which spreads upwards from the ground by the process of eddy diffusion and radiation exchange, there may be an additional general cooling of the air layers near the ground caused by radiation exchange with the upper atmosphere.

R. G. VERYARD.

Monthly Charts of Rainfall over Germany‡

We have received from the Director of the German Meteorological Service (Reichsamt für Wetterdienst) copies of a new series of monthly rainfall charts. The first issue includes charts for January to May, 1935. The charts are on the scale 1 : 10^6 (1 inch = 16 miles approximately) which entails the use of sheets about 4 feet by 3 feet in size. These, however, fold neatly to about 1 foot square for storage purposes. Isohyetal lines are drawn for every 10 millimetres of rain up to 100 mm., then at intervals of 20 mm. up to 200 mm., and at intervals of 50 mm. for greater amounts. Blue colouring is used to indicate amounts above 60 mm. and buff colouring to indicate amounts under 60 mm. Four shades of blue tone and three shades of buff tone are employed, and the distribution of rainfall is thus very clearly displayed. In this connexion the only criticism we have to make is that in wet months large areas of high ground, in which the variation of rainfall is very great, are uniformly tinted dark blue.

* *Beitr. Geophysik, Leipzig*, 37, 1932, p. 116.
† *Bangalore, Proc. Ind. Acad. Sci.*, 1, 1935, No. 11.
‡ Die Verteilung der Niederschläge in Deutschland im Januar bis Mai, 1935. Berlin Reichsamt für Wetterdienst, 1935.

The dark blue tint is actually produced by hatching in black lines over the blue printing. A distinction between areas with rainfall above and below say 250 mm. could thus be easily made by omitting the blue tinting over the former areas.

Dr. Weickmann has kindly furnished the following additional information. The charts are based on readings from about 4,100 stations, 800 of which are over 500 m. and 100 over 1,000 m. above mean sea level. The observations are collected and charted initially by the services centred at Königsberg, Berlin, Dresden, Breslau, Münster, Munich, and Stuttgart, and the final maps are prepared at Berlin under the supervision of Professor Knoch.

These magnificent charts set a new standard to all meteorological services in the presentation of rainfall data. The large scale employed makes it possible to show the distribution of rainfall to a degree of detail not hitherto attempted in published charts. We congratulate our German colleagues on their achievement and look forward with interest to the publication of further charts in the series.

E. G. BILHAM.

Föhn Winds in the Alps

In the *Meteorological Magazine* for February, 1936, p. 24, there appears the following statement, presumably copied from the Press :—" The Föhn wind was blowing in Switzerland on the 2nd ; rain fell up to the 4,000 feet level, but heavy snow above 6,000 feet." The wind " föhn " is universally used in the Alps to denote a winter thaw, but since this meaning of the term has only a slight and incidental relationship to the accepted meteorological usage, there is no reason why scientific journals should conform to it. So far as I am aware, the meteorological term was originally derived from the local name for warm, dry, descending winds in the northern Alpine valleys. Nowadays a greatly extended use of the term has become general among the natives, but this practice was quite probably started by visitors who thought they knew something about meteorology.

Winter thaws in the Alps, on slopes facing any direction in the northern semicircle, are invariably due to incursions of warm damp air. Genuine tropical air produces a thaw often extending up to 7,000 feet (higher in extreme cases) even at the coldest season, and the mildest varieties of maritime polar air may cause a thaw up to fully 5,000 feet. Since in such conditions there is usually a steep gradient for SW. winds, there is often some genuine föhn on the north side of the Alps, but on other occasions there is general precipitation and no föhn. In any case the föhn is in no sense the cause of the thaw. In so far as the condition of the snow surface is controlled by the over-lying air, the important feature is the wet-bulb temperature, and the föhn process leaves this unaffected when the

air returns to its original pressure, as Dr. Normand* pointed out. If the dry bulb temperature only is raised, the effect on the snow surfaces is an increase of evaporation. If the snow covering were thin, as it may be in the early winter, excessive evaporation would damage ski-ing prospects, but such an event is certainly rare. I have spent many weeks in the Alps in January and February, and the snow has never been affected by evaporation, though it has often been spoilt by thaws and the crust which follows unless and until there is a fresh snowfall. C. K. M. DOUGLAS.

"Greenhouse" effect in the Upper Atmosphere.

In my Note appearing under the above title in the March number of the *Meteorological Magazine*, I should have mentioned that the experiment therein described was not original. About the year 1909 the Upper Air Station of the University of Manchester at Glossop Moor sent up a thin-walled rubber balloon with a Dines meteorograph inside. They found that in the stratosphere the temperature inside the balloon was about 50° C. higher than that of the surrounding air. Recently, Professor E. Regener of Stuttgart has sent up instruments enclosed in cellophane, and published the results. Having to solve a particular problem of keeping an instrument warm in the stratosphere I followed his method in the specific case described in my note, and gladly acknowledge my indebtedness to him.

L. H. G. DINES.

OBITUARY

Henry Victor Prigg.—We regret to record the death on March 28th of Mr. H. Victor Prigg, at the age of 70. Mr. Prigg's association with meteorology began in 1892 when he became observer at the Plymouth Meteorological Station. Later he was appointed to the position of City Meteorologist, and he has thus been closely engaged on climatological work for the long period of 44 years. His death deprives Plymouth of a very distinguished citizen, and the Meteorological Office of a valued co-operating worker. He was well known as a man of kindly personality, and was ready at all times to place his great knowledge of local climatology at the disposal of anyone seeking information.

Kapitan Siegfried Luensee.—We regret to learn of the death on January 11th, 1936, after a long and painful illness of Capt. S. Luensee, Marine Superintendent in the Deutsche Seewarte. Capt. Luensee was born in Berlin on January 29th, 1878, and went to sea at the age of fifteen. After serving in the German Mercantile Marine,

* *Poona, Mem., Indian met. Dep.* **23**, 1921, No. 1, p. 18. See also Physical and Dynamical Meteorology, by D. Brunt, p. 86.

Navy and Naval Airship Division, he entered the Deutsche Seewarte as a nautical assistant in 1920 and succeeded Capt. Schubart as Marine Superintendent in 1932. During this time he contributed many articles on nautical subjects to various publications, one of the latest he wrote being on "Meteorologische Navigation." At the International Meteorological Conference at Copenhagen in 1929 he was appointed Secretary of the International Commission for Marine Meteorology.

William Davies.—We regret to learn of the death of Mr. W. Davies at Holyhead on March 7th, 1936. Mr. Davies for many years looked after the anemometers at the anemometer station at Salt Island, Holyhead, and when, in 1913, the Holyhead climatological station was also transferred to Salt Island he became the full-time observer. He continued in that capacity until 1928.

We regret to learn of the death, on March 31st, 1936, at Bushy House, Teddington, of Sir Joseph E. Petavel, D.Sc., F.R.S., Director of the National Physical Laboratory.

The Weather of March, 1936

Pressure was below normal over the United States, most of southern Canada, north Alaska, the north coast of Africa, central and south-west Europe and the Azores, the greatest deficits being 6·1 mb. at James Bay, Ontario, 5·4 mb. at Pt. Barrow, Alaska, and 7·8 mb. at Brest. Pressure was above normal elsewhere in Europe and in western Siberia and from Bermuda to Greenland and thence across most of northern Canada, the greatest excesses being 5·4 mb. at Astrakhan, 7·0 mb. at Haparanda and 8·6 mb. near St. John's, Newfoundland. Temperature was above normal at Spitsbergen, in southern Scandinavia and central Europe, but below normal in northern Scandinavia and Portugal, while precipitation was generally below normal.

The main feature of the weather of March over the British Isles was the deficiency of sunshine, many new low records being established. Wintry conditions prevailed at first but during the greater part of the month the weather was mild and dull. On the 1st and 2nd cold northerly winds were experienced and snow fell in most parts of the country except the south-west, being heavy in the north Midlands. Floods occurred in Cheshire on the 1st and in south-east Yorkshire on the 1st–3rd, while gales were experienced in north Scotland on the 1st and in north Wales on the 2nd. Maximum temperatures did not exceed 36° F. in many inland places on the 1st and 2nd. From the 3rd–5th a depression, centred at first near Iceland, moved slowly eastwards giving rain generally in the south, with snow and sleet in north England and Scotland, and on the 4th S.–SW. gales in extreme north Scotland. Thick fog was prevalent in east England and the Midlands on the 3rd–4th. By the 5th temperature was rising some-

what generally and from then to the 10th complex low pressure areas covered the country. Conditions were generally mild with fog or mist in many parts and slight to moderate rain, except in Scotland where snow or sleet occurred on the 8th and 9th. In the south the warmest day was the 10th, when 62° F. was reached at Tunbridge Wells. During these first ten days good sunshine records were obtained in isolated areas on some days, 10·4 hrs. at Tiree and 9·5 hrs. at Mallarany on the 10th, 9·3 hrs. at Auchincruive on the 2nd and 9·1 hrs. at Ventnor on the 4th and 5th. By the 11th a narrow ridge of high pressure stretched across the country and in the south temperature was considerably lower with easterly winds. From the 12th–18th anticyclonic conditions prevailed—until the 16th the weather was cold, dull and dry in England and south Scotland, with maximum temperatures not rising above 37° F. at a few places on the 13th and 14th, while in north Scotland and Ireland slight rain and much sun occurred at times—in Ireland temperature was mainly above normal. On the 16th there was a general change to warmer weather with much sun in the south but less in the north, 10·5 hrs. were recorded at Bath, Portsmouth and Calshot on the 18th. During the 18th a depression moved northward from the Bay of Biscay and from then to the 24th remained centred to the west of the British Isles giving generally unsettled mild weather with rain at times but sunny periods—the 24th was the sunniest day over the whole country when 11·1 hrs. were recorded at Lympne and Hastings. Thunderstorms occurred in the north on the 20th and in the Midlands on the 23rd. On the 25th the centre of the low pressure area moved towards the English Channel and easterly winds prevailed until the 27th, but temperatures remained generally above normal, though there was not so much sun except at isolated places. Fog occurred in many parts during this period, and moderate to heavy rain in the south-west on the 26th. From the 28th–31st the main centre of the low pressure area was again to the west of the British Isles. Moderate to heavy rain occurred in the south and west, 2·35 in. at Snowdon (Carnarvon) on the 29th and 1·45 in. at Holne (Devon) on the 28th, but elsewhere the mild unsettled conditions continued with some rain and sunny intervals. Coastal mist or fog occurred locally. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	91	−14	Chester ...	57	−56
Aberdeen ...	62	−45	Ross-on-Wye...	70	−38
Dublin	69	−48	Falmouth ...	98	−37
Birr Castle ...	77	−33	Gorleston ...	89	−34
Valentia... ...	107	− 8	Kew	78	−25

Miscellaneous notes on weather abroad culled from various sources

A severe storm passed over Sicily and the extreme south of Italy on the 4th ; five fishing boats were wrecked at Palermo, and at

Taranto 300 people were stated to have been injured, rivers were in flood and many houses collapsed. After a series of gales the sea dykes in the Médoc Peninsula near Bordeaux gave way and sea water covered about 3,000 acres of sown land. Yellow snow was reported in the canton of Ticino, on the Simplon Pass, and in Piedmont on the 6th, while after heavy rain in a valley near Bergamo, Lombardy the trees and fields were found covered with a light powder. Ice conditions off the Finnish coast became worse about the 8th owing to SE. winds, and the ice-breakers were unable to keep the port of Hangö open. The port of Seville was closed on the 11th as the water was rising. After heavy rain at Barcelona about the 14th–16th it was stated that thin coatings of mud were found on trees, window panes, etc. Heavy rain again caused serious floods throughout Portugal about the 26th. The river Guadalquivir rose alarmingly by the 27th but the port of Seville could be re-opened on the 28th as the water was subsiding. Navigation was re-opened at Kotka (Finland) on the 29th. (*The Times*, March 5th–30th.)

Motor traffic was interrupted in many places on the North-West Frontier about the 5th owing to ten days heavy rain. The icefield outside the Taku bar in the port of Tientsin was breaking up on the 5th releasing many steamers. (*The Times*, March 5th–9th.)

The Finke river in central Australia was still in flood on the 5th. The total rainfall for the month was generally above normal in Queensland and New South Wales but mainly considerably below normal elsewhere. (*The Times*, March 6th and cable.)

Rapidly melting snow and heavy rain caused severe floods in many parts of the north-eastern United States between about the 10th and 15th. By the 12th conditions were improving in New York State and Pennsylvania and by the 15th the floods were receding generally. On the 17th, however the rivers in Pennsylvania, Maryland, West Virginia and New York, swollen by sudden heavy rains and melted snow and ice swept over their banks again and inundated several towns and wide stretches of the countryside. There were also floods generally in the eastern States from the Canadian border to South Carolina. In western Pennsylvania the floods were receding on the 19th and 20th but the rivers in the 13 other flooded States were still rising. Heavy snow fell on the 21st in the flooded areas of the Ohio and in Maryland, western Pennsylvania and western New York reaching blizzard force near the Niagara Falls. By the 23rd the rivers however were receding everywhere though on the 25th, the Ohio, Monongahela and Allegheny rivers rose again for a short time. 181 people are known to have been drowned in these floods while the damage to property in New England alone is estimated at over 10 million pounds. Heavy rain in parts of the Middle West on the 23rd raised the Mississippi to near the flood stage. A tornado swept across south-west Missouri on the 23rd, while in southern Kansas, Oklahoma and Texas there were dust storms, and snow was falling in western Kansas and south-east Colorado. A

sharp thaw occurred in eastern Canada about the 20th but serious floods were only experienced in the southern districts of Ontario. A short, very warm spell was experienced in Newfoundland about the 21st when 66° F. was reached at St. John's, a record for March. In the United States, temperature was generally above normal except during the later part of the month in the west, and precipitation mainly below normal. (*The Times*, March 13th–26th and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, March, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	989·8	WNW.2	34	39	77	0·06	0·0	r_0–r_0s_0 0h.–9h.
2	999·5	NNE.2	36	42	69	0·01	0·0	r_0 5h.–9h., r_0h_0–17h.
3	1009·8	ENE.1	37	41	71	—	0·0	f 21h.
4	1014·4	W.1	27	38	91	trace	0·5	f 0h.–20h. r_0 24h.
5	1010·9	WNW.2	32	49	58	0·09	6·2	r 0h.–5h.
6	1011·4	WNW.3	35	49	50	0·02	4·6	r–r_0 5h.–6h.
7	1010·5	S.3	32	49	70	trace	0·1	fx early. r_0 17h.–21h.
8	1011·8	E.2	44	54	85	—	0·4	
9	1008·4	S.3	44	55	75	0·04	0·1	r_0 2h.–7h. & 15h.–24h.
10	1010·3	NE.3	47	58	65	trace	0·1	r_0 0h.–2h. f 9h.
11	1009·8	ENE.3	42	46	85	—	0·0	d_0 9h.
12	1013·4	ENE.3	39	42	63	—	0·0	
13	1018·1	E.3	37	42	61	—	0·4	
14	1023·8	E.2	35	44	61	—	2·4	
15	1024·6	NW.2	31	44	71	—	0·2	
16	1024·7	N.2	38	49	50	—	3·9	
17	1023·8	WSW.2	33	52	62	—	5·5	x early. f 8h.–11h.
18	1020·4	E.3	31	54	39	—	8·7	Fx till 8h.
19	1011·8	SE.3	38	58	57	—	5·0	x early. r_0 19h.
20	1011·6	SSE.2	47	53	94	0·11	0·7	r_0 7h.–9h. & 12h.–13h.
21	1009·2	SE.4	44	62	55	—	5·2	
22	1000·5	S.4	51	60	58	—	3·3	r_0 23h.
23	994·6	ESE.3	51	55	75	0·10	0·7	r–r_0 3h.–9h. & 13h–
24	1007·6	E.4	42	61	57	—	9·3	w early. [16h.
25	1005·0	ENE.4	46	60	61	—	4·3	
26	1001·2	SE.2	46	54	94	0·31	0·1	r–r_0 2h.–15h.
27	1007–1	S.4	45	57	69	0·02	3·2	r_0 9h. & 21h.
28	1010·9	S.E.2	43	59	68	—	5·5	w early.
29	1005·2	S.4	51	58	91	0·11	0·1	r_0–r 6h.–14h.
30	1009·7	SW.3	49	59	76	—	3·9	r_0 1h.–2h. pr_0 13h.
31	1011·7	SSW.3	49	60	88	0·04	3·9	r–r_0 11h.–12h. & 24h.
*	1010·4	—	41	52	69	0·90	2·5	* Means or totals.

General Rainfall for March, 1936

England and Wales ...	90	per cent. of the average 1881–1915.
Scotland	71	
Ireland	86	
British Isles	85	

Rainfall : March, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	1·11	61	*Leics* .	Thornton Reservoir ...	1·85	100
Sur .	Reigate, Wray Pk. Rd..	1·79	76	,, .	Belvoir Castle............	1·10	61
Kent .	Tenterden, Ashenden...	1·23	58	*Rut* .	Ridlington	1·42	82
,, .	Folkestone, Boro. San.	·85	...	*Lincs* .	Boston, Skirbeck.........	1·17	75
,, .	Eden'bdg., Falconhurst	1·17	47	,, .	Cranwell Aerodrome...	1·17	84
,, .	Sevenoaks, Speldhurst.	1·35	...	,, .	Skegness, Marine Gdns.	·78	47
Sus .	Compton, Compton Ho.	2·97	107	,, .	Louth, Westgate.........	·95	45
,, .	Patching Farm..........	1·96	91	,, .	Brigg, Wrawby St.......	·76	...
,, .	Eastbourne, Wil. Sq....	1·30	57	*Notts* .	Worksop, Hodsock......	1·54	91
,, .	Heathfield, Barklye....	1·30	52	*Derby*.	Derby, L. M. & S. Rly.	1·92	112
Hants.	Ventnor, Roy.Nat.Hos.	2·32	114	,, .	Buxton, Terr. Slopes...	3·13	76
,, .	Fordingbridge, Oaklnds	3·45	148	*Ches* .	Runcorn, Weston Pt....	1·57	77
,, .	Ovington Rectory.......	2·58	100	*Lancs*.	Manchester, Whit. Pk.	1·47	65
,, .	Sherborne St. John......	1·86	83	,, .	Stonyhurst College......	2·43	66
Herts .	Royston, Therfield Rec.	1·01	55	,, .	Southport, Bedford Pk.	1·87	84
Bucks.	Slough, Upton............	1·23	70	,, .	Lancaster, Greg Obsy.	2·03	64
,, .	H. Wycombe, Flackwell	1·62	81	*Yorks*.	Wath-upon-Dearne......	1.62	93
Oxf .	Oxford, Mag. College...	1·79	117	,, .	Wakefield,Clarence Pk.	1·73	96
Nor .	Wellingboro, Swanspool	1·42	79	,, .	Oughtershaw Hall.......	3·70	...
,, .	Oundle	1·04	...	,, .	Wetherby, Ribston H..	...	...
Beds .	Woburn, Exptl. Farm...	1·34	78	,, .	Hull, Pearson Park......	·66	36
Cam .	Cambridge, Bot. Gdns.	·53	36	,, .	Holme-on-Spalding......	1·12	62
Essex.	Chelmsford,County Gdns	·81	47	,, .	West Witton, Ivy Ho.	2·18	70
,, .	Lexden Hill House......	·68	...	,, .	Felixkirk, Mt. St. John.	1·91	97
Suff .	Haughley House.........	·54	...	,, .	York, Museum Gdns....	1·01	60
,, .	Campsea Ashe............	·59	35	,, .	Pickering, Hungate......	1·41	71
,, .	Lowestoft Sec. School...	·41	25	,, .	Scarborough...............	1·04	58
,, .	Bury St. Ed., WestleyH.	·57	30	,, .	Middlesbrough............	1·30	83
Norf. .	Wells, Holkham Hall...	·63	39	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk......	2·72	...	*Durh* .	Ushaw College............	2·59	118
,, .	Porton, W.D. Exp'l. Stn	2·41	122	*Nor* .	Newcastle, D. & D. Inst.	1·47	77
Dor .	Evershot, Melbury Ho.	4·94	166	,, .	Bellingham, Highgreen	2·98	101
,, .	Weymouth, Westham.	3·78	183	,, .	Lilburn Tower Gdns....	2·00	76
,, .	Shaftesbury,Abbey Ho.	3·58	152	*Cumb*.	Carlisle, Scaleby Hall...	1·31	53
Devon.	Plymouth, The Hoe....	3·73	128	,, .	Borrowdale, Seathwaite	8·75	83
,, .	Holne, Church Pk. Cott.	7·25	135	,, .	Borrowdale, Moraine...	6·45	77
,, .	Teignmouth, Den Gdns.	4·62	177	,, .	Keswick, High Hill......	2·32	52
,, .	Cullompton	3·97	145	*West* .	Appleby, Castle Bank...	1·89	70
,, .	Sidmouth, U.D.C.........	4·12	...	*Mon* .	Abergavenny, Larchf'd	3·60	118
,, .	Barnstaple, N. Dev.Ath	2·39	91	*Glam* .	Ystalyfera, Wern Ho....	4·48	84
,, .	Dartm'r,Cranmere Pool	5·60	...	,, .	Cardiff, Ely P. Stn.......	3·88	121
,, .	Okehampton, Uplands.	3·99	96	,, .	Treherbert, Tynywaun.	6·84	...
Corn .	Redruth, Trewirgie......	4·93	137	*Carm* .	Carmarthen, Coll. Rd.	2·74	72
,, .	Penzance, Morrab Gdns.	4·43	138	*Pemb* .	St. Ann's Hd. C. Gd. Stn.	2·61	101
,, .	St. Austell, Trevarna...	5·78	168	*Card* .	Aberystwyth	1·99	...
Soms .	Chewton Mendip.........	4·25	119	*Rad* .	BirmW.W.Tyrmynydd	4·00	75
,, .	Long Ashton.............	2·51	99	*Mont* .	Lake Vyrnwy	4·79	111
,, .	Street, Millfield...........	3·16	...	*Flint* .	Sealand Aerodrome......	1·99	...
Glos .	Blockley	1·91	...	*Mer* .	Dolgelley, Bontddu......	3·87	79
,, .	Cirencester, Gwynfa....	2·06	89	*Carn* .	Llandudno	2·33	115
Here .	Ross, Birchlea............	2·90	143	,, .	Snowdon, L. Llydaw 9..	12·10	...
Salop.	Church Stretton.........	2·60	110	*Ang* .	Holyhead, Salt Island...	2·71	103
,, .	Shifnal, Hatton Grange	2·15	117	,, .	Lligwy	3·00	...
Staffs.	Market Drayt'n, Old Sp.	2·17	102	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	2·89	170		Douglas, Boro' Cem....	2·67	90
War .	Alcester, Ragley Hall...	2·17	126	*Guernsey*			
,,	Birminghm, Edgbaston	2·31	121		St. PeterP't.Grange Rd.	3·15	127

Rainfall: March, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith	2·16	76	*Suth*	Melvich	1·32	46
„	New Luce School	2·62	74	„	Loch More, Achfary	4·39	68
Kirk	Dalry, Glendarroch	3·79	84	*Caith*	Wick	1·37	60
„	Carsphairn, Shiel	5·24	86	*Ork*	Deerness	1·55	55
Dumf.	Dumfries, Crichton R.I.	2·67	95	*Shet*	Lerwick	2·37	75
„	Eskdalemuir Obs	4·59	94	*Cork*	Caheragh Rectory	...	...
Roxb	Hawick, Wolfelee	2·93	87	„	Dunmanway Rectory	4·31	88
Selk	Ettrick Manse	...	...	„	Cork, University Coll	3·21	107
Peeb	West Linton	3·06	...	„	Ballinacurra	2·65	93
Berw	Marchmont House	2·52	95	„	Mallow, Longueville	3·18	110
E.Lot	North Berwick Res	1·71	91	*Kerry*	Valentia Obsy	3·52	78
Midl	Edinburgh, Blackfd. H.	1·74	88	„	Gearhameen	5·20	64
Lan	Auchtyfardle	1·94	...	„	Bally McElligott Rec	2·19	...
Ayr	Kilmarnock, Kay Pk	2·35	...	„	Darrynane Abbey	2·55	62
„	Girvan, Pinmore	2·97	79	*Wat*	Waterford, Gortmore	3·42	125
Renf	Glasgow, Queen's Pk	2·73	105	*Tip*	Nenagh, Cas. Lough	2.37	76
„	Greenock, Prospect H.	4·04	82	„	Roscrea, Timoney Park	1.80	...
Bute	Rothesay, Ardencraig	3·11	...	„	Cashel, Ballinamona	2·34	86
„	Dougarie Lodge	2·94	...	*Lim*	Foynes, Coolnanes	1·89	64
Arg	Ardgour House	4·69	...	„	Castleconnel Rec	2·59	...
„	Glen Etive	...	...	*Clare*	Inagh, Mount Callan	3·53	...
„	Oban	2·16	...	„	Broadford, Hurdlest'n.	...	...
„	Poltalloch	4·11	107	*Wexf*	Gorey, Courtown Ho	3·80	164
„	Inveraray Castle	5·43	86	*Wick*	Rathnew, Clonmannon	2·99	...
„	Islay, Eallabus	3.90	102	*Carl*	Hacketstown Rectory	3·55	127
„	Mull, Benmore	...	...	*Leix*	Blandsfort House	2·57	99
„	Tiree	2.54	76	*Offaly*	Birr Castle	1·54	64
Kinr	Loch Leven Sluice	...	...	*Dublin*	Dublin, FitzWm. Sq	1·74	90
Fife	Leuchars Aerodrome	2·33	119	„	Balbriggan, Ardgillan	...	...
Perth	Loch Dhu	...	...	*Meath*	Beauparc, St. Cloud	2·11	...
„	Balquhidder, Stronvar	4·05	...	„	Kells, Headfort	1·94	71
„	Crieff, Strathearn Hyd.	2·60	81	*W.M*	Moate, Coolatore	2·07	...
„	Blair Castle Gardens	1·69	65	„	Mullingar, Belvedere	2·30	85
Angus	Kettins School	2·02	83	*Long*	Castle Forbes Gdns	2·09	71
„	Pearsie House	2·15	...	*Gal*	Galway, Grammar Sch.	1·90	...
„	Montrose, Sunnyside	1·89	91	„	Ballynahinch Castle	3·52	69
Aber	Braemar, Bank	1·48	50	„	Ahascragh, Clonbrock	2·53	76
„	Logie Coldstone Sch	1·12	43	*Mayo*	Blacksod Point	2.29	56
„	Aberdeen, Observatory	1·63	68	„	Mallaranny	3·41	...
„	Fyvie Castle	1·31	48	„	Westport House	2·41	62
Moray	Gordon Castle	·63	27	„	Delphi Lodge	5·44	65
„	Grantown-on-Spey	...	...	*Sligo*	Markree Castle	3·03	89
Nairn	Nairn	·83	44	*Cavan*	Crossdoney, Kevit Cas.	2·78	...
Inv's	Ben Alder Lodge	2·17	...	*Ferm*	Enniskillen, Portora	2·53	...
„	Kingussie, The Birches	·91	...	*Arm*	Armagh Obsy	1·67	71
„	Inverness, Culduthel R.	1·43	...	*Down*	Fofanny Reservoir	9·24	...
„	Loch Quoich, Loan	5·35	...	„	Seaforde	3·40	116
„	Glenquoich	5·18	53	„	Donaghadee, C. G. Stn.	1·98	90
„	Fort William, Glasdrum	3·21	...	„	Banbridge, Milltown	...	...
„	Skye, Dunvegan	2·87	...	*Antr*	Belfast, Cavehill Rd	2·39	...
„	Barra, Skallary	2·47	...	„	Aldergrove Aerodrome	2·15	86
R&C	Alness, Ardross Castle	1·22	37	„	Ballymena, Harryville	2·67	85
„	Ullapool	1·54	37	*Lon*	Garvagh, Moneydig	2·43	...
„	Achnashellach	3·88	54	„	Londonderry, Creggan	2·54	79
„	Stornoway, Matheson	1·64	40	*Tyr*	Omagh, Edenfel	2·54	81
Suth	Lairg	1·66	54	*Don*	Malin Head	2·09	...
„	Tongue	1·33	40	„	Killybegs, Rockmount	2·04	...

Climatological Table for the British Empire, October, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. (mb.)	PRESSURE. Diff. from Normal. (mb.)	TEMPERATURE. Absolute. Max. (°F.)	TEMPERATURE. Absolute. Min. (°F.)	TEMPERATURE. Mean Values. Max. (°F.)	TEMPERATURE. Mean Values. Min. (°F.)	TEMPERATURE. Mean Values. ½ Max. and Min. (°F.)	TEMPERATURE. Mean Values. Diff. from Normal (°F.)	TEMPERATURE. Mean. Wet Bulb. (°F.)	Relative Humidity. (%)	Mean Cloud Am'nt (0–10)	PRECIPITATION. Am'nt. (in.)	PRECIPITATION. Diff. from Normal. (in.)	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Per-centage of possible.
London, Kew Obsy....	1010·8	− 3·2	62	28	56·5	44·8	50·7	+ 0·8	45·9	88	7·1	1·98	− 0·72	13	3·1	29
Gibraltar..................	1017·1	− 0·1	79	51	72·1	57·6	64·9	− 1·5	56·1	79	3·9	1·97	− 1·30	5	...	...
Malta........................	1015·5	− 0·5	91	55	77·5	67·5	72·5	+ 1·6	66·2	74	5·0	1·00	− 1·87	9	8·0	71
St. Helena	1013·9	− 0·4	72	53	62·8	55·1	58·9	+ 0·6	56·4	92	9·7	0·62	...	9	...	...
Freetown, Sierra Leone	1012·5	+ 2·6	90	68	85·3	71·9	78·6	− 1·5	75·1	86	7·2	16·46	+ 3·84	24	...	...
Lagos, Nigeria	1011·3	+ 0·3	88	72	85·4	75·2	80·3	+ 0·6	75·9	85	7·4	6·08	− 1·69	16	6·1	51
Kaduna, Nigeria	1007·7	...	93	65	88·5	67·4	77·9	+ 1·6	72·4	85	4·8	2·89	+ 0·14	9	8·3	70
Zomba, Nyasaland	1010·3	− 0·6	93	58	87·1	64·5	75·8	+ 1·7	63·9	44	2·6	0·00	− 1·52	0	...	...
Salisbury, Rhodesia...	1011·9	+ 0·1	91	52	84·8	57·4	71·1	+ 0·4	58·2	37	0·8	0·10	− 1·03	2	9·8	78
Cape Town	1018·2	+ 0·8	86	45	71·0	53·9	62·5	+ 1·3	55·5	72	4·9	1·05	− 0·60	7	...	...
Johannesburg	1012·5	+ 1·0	90	42	79·7	54·4	67·1	+ 4·3	53·2	42	2·8	1·08	− 1·48	7	9·7	76
Mauritius	1017·9	− 0·3	85	59	80·1	65·1	72·6	− 0·1	68·0	67	4·7	1·26	− 0·12	15	8·8	70
Calcutta, Alipore Obsy.	1008·9	− 0·5	93	66	90·9	73·9	82·4	+ 3·1	74·2	81	2·4	0·91	− 3·99	2*	...	...
Bombay	1008·8	− 1·0	97	72	90·0	76·9	83·5	+ 1·1	76·3	81	5·6	1·04	− 0·63	2*	...	...
Madras	1007·8	− 1·1	95	72	88·7	75·4	82·1	− 0·2	76·6	81	6·6	15·53	+ 4·38	9*	...	...
Colombo, Ceylon	1009·7	− 0·3	87	70	84·4	74·6	79·5	− 1·0	76·5	79	7·7	23·65	+ 10·29	24	5·6	47
Singapore	1008·8	− 0·9	89	74	86·0	76·3	81·1	0·0	77·7	79	7·8	4·06	− 4·01	13	5·1	42
Hongkong..................	1012·7	+ 1·0	89	70	82·0	74·8	78·4	+ 1·5	74·1	79	6·7	5·81	+ 0·87	11	6·0	51
Sandakan	1008·8	...	91	72	88·5	75·1	81·8	+ 0·4	77·7	82	7·6	12·58	+ 2·25	24	...	...
Sydney, N.S.W..........	1015·2	+ 0·4	96	51	72·8	56·3	64·5	+ 0·9	59·0	59	6·0	3·48	+ 0·63	13	8·0	62
Melbourne	1015·4	+ 0·6	87	38	67·5	48·2	57·9	+ 0·2	53·4	65	7·0	2·89	+ 0·26	17	5·0	39
Adelaide	1016·2	+ 0·2	90	42	72·7	53·0	62·9	+ 0·9	55·6	51	6·5	2·63	+ 0·90	12	6·7	52
Perth, W. Australia ...	1017·9	+ 1·1	81	42	68·3	50·6	59·5	− 1·3	53·4	60	4·3	2·20	− 0·02	10	9·3	73
Coolgardie	1015·1	0·0	90	38	73·4	47·7	60·5	− 3·2	55·8	68	3·8	2·78	+ 2·12	8	...	...
Brisbane..................	1016·9	+ 0·7	91	55	78·6	61·1	69·9	+ 0·1	63·6	63	5·2	4·93	+ 2·40	11	8·3	65
Hobart, Tasmania......	1012·1	+ 1·8	81	37	61·4	45·4	53·4	− 0·7	48·2	60	6·5	2·58	+ 0·32	18	6·3	48
Wellington, N.Z.	1012·0	− 1·1	65	39	58·4	47·8	53·1	− 1·3	51·4	81	7·8	5·12	+ 1·04	18	5·1	39
Suva, Fiji	1013·2	0·0	88	69	81·4	72·2	76·8	+ 1·0	73·2	86	8·3	16·34	+ 8·05	26	3·7	30
Apia, Samoa	1010·9	− 0·6	87	72	85·7	75·9	80·8	+ 2·4	77·0	74	5·5	3·61	− 2·77	19	8·4	68
Kingston, Jamaica	1010·2	− 1·3	89	67	85·4	71·9	78·7	− 1·8	71·5	88	6·5	10·08	+ 2·62	16	3·8	32
Grenada, W.I.	...	...	90	72	86	75	80·5	+ 0·4	75	79	4	5·33	− 2·43	12	...	...
Toronto....................	1021·0	+ 3·5	79	27	59·2	41·1	50·1	+ 1·5	43·2	83	6·0	1·57	− 1·00	15	5·8	52
Winnipeg	1015·6	+ 0·7	74	11	50·1	30·5	40·3	− 0·4	...	...	4·9	0·62	− 0·75	6	4·2	39
St. John, N.B.	1020·3	+ 4·5	62	28	54·4	39·5	46·9	+ 1·6	43·0	80	4·9	1·46	− 3·08	14	6·4	58
Victoria, B.C............	1019·1	+ 2·0	77	27	55·0	44·6	49·8	− 0·5	47·0	84	6·5	2·52	− 0·05	12	4·8	44

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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St. John, N.B.	1020·3	+ 4·5	62	28	54·4	39·5	46·9	+ 1·6	43·0	80	4·9	1·46	—	3·08	14	6·4	58
Victoria, B.C.	1019·1	+ 2·0	77	27	55·0	44·6	49·8	— 0·5	47·0	84	6·5	2·52	—	0·05	12	4·8	44

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.